IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:	Confirmation No.: 2091
Carver et al.	Group Art Unit: 3663
Serial No.: 10/795,879	Examiner: Dudnikov, Vadim
Filed: March 8, 2004	Docket Number: 61404-1100

For: **CONTAINER AND METHOD FOR STORING OR TRANSPORTING SPENT NUCLEAR FUEL**

SECOND DECLARATION OF CHARLES PENNINGTON UNDER 37 CFR §1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

1. I possess an undergraduate degree in mathematics from Duke University, and an M.S. in Nuclear Engineering from North Carolina State University. I also possess an MBA from the University of Connecticut. I have been associated with the nuclear energy industry, both commercial and military, for 40 years. In that time, I have authored at least 50 articles and presentations for various publications and organizations relating to the storage of spent nuclear fuel and other topics relating to nuclear energy.

2. I am currently Vice President of Marketing and Business Development for NAC International, a U.S. company with a significant leadership role in the United States for the storage and transportation of spent nuclear fuel. I have also served for five years as the Director of the Nuclear Spent Fuel Academy sponsored by NAC International

which is a one-week colloquium on spent nuclear fuel storage and transport offered to industry, academia, and government.

3. I am named an inventor of patents relating to spent nuclear fuel storage and transport technology involving neutron absorbers for criticality control and special canister system designs for spent fuel storage and transport, including methods for heat removal from exothermic materials. I have served as a consultant to the International Atomic Energy Agency relating to casks for spent nuclear fuel and have served as an expert witness for several utility companies supporting their Federal licensing, state approval, and litigation activities relating to spent nuclear fuel transport and storage. I have provided both closed-door and public presentations to the National Academy of Sciences and the Nuclear Regulatory Commission on the safety and security of the storage and transport of dry spent nuclear fuel.

4. I have previously led the Engineering and Design Services business unit within NAC for five years. This unit performs the design, Federal licensing, and implementation of storage and transportation systems for spent nuclear fuel. In this role, I directed development, design, and Federal licensing of storage and transport systems for spent nuclear fuel including the NAC-MPC®, UMS®, Advanced UMS®, and other systems.

5. Before joining NAC International, I served as Vice President for Technology and Business Development for Holtec International where I directed the development of

technology for nuclear and hazardous material storage and transport. Prior to my employment at Holtec International, I served as Vice President for Transnuclear, Inc., where I was involved in design development, fabrication assessment, commercialization, and marketing efforts for several spent nuclear fuel dual purpose metal casks, metal spent fuel storage casks, and other types of casks.

6. I have been made aware of the contents of U.S. Patent Application 10/795,879 entitled "Container and Method for Storing or Transporting Spent Nuclear Fuel" (hereafter "the '879 application"). The '879 application involves the storage and transport system fuel basket design for spent nuclear fuel that employs so called rod and recess technology.

7. I further have been made aware of the rejection of claims 1, 6 ,and 7 in this patent application under 35 U.S.C. §103(a) as being allegedly unpatentable over U.S. Patent 6,009,136 issued to Loftis *et al.* (hereafter "Loftis") in view of an online catalog item of Hoover Fence Company (hereafter "Hoover"). I have also been made aware of the rejection of claims 8-10, 13-34, 48-51, and 53-58 in this patent application under 35 U.S.C. §103(a) as being allegedly unpatentable over Loftis in view of U.S. Patent 4,630,738 issued to Bosshard (hereafter "Bosshard") in view of U.S. Patent Application Publication 2002/0015614 A1 filed by Lindsay (hereafter "Lindsay") and further in view of Hoover. In view of these rejections, I set forth the following information.

8. The "rod and recess" technology as referred to herein involves various elements of the claims of the above-referenced patent application. For example, among other elements, at least one of the independent claims in present application includes an element in which rods are seated in the recesses of respective pairs of the tubes such that the walls of the rods contact the recesses of the tubes disposed in a container. Also, at least one independent claim further recites the feature that respective sidewalls of tubes having corners engaged with each other are in "substantial alignment." These features and other elements of at least the independent claims are features of the "rod and recess" technology that result in increased capacity for the storage of spent nuclear fuel described above. Specifically, positioning the rods in the recesses results in the fuel being stored in closer proximity, thereby increasing the amount of spent nuclear fuel that can be stored in each container. For pressurized water reactor systems, the containers that employ the "rod and recess" design falling within the scope of the claims of the above-referenced patent application as set forth above facilitate an increase of approximately 16% in the amount of spent nuclear fuel that could be stored with a minimal increase in the weight and size of the storage containers as compared to other competitor containers available on the market. Similarly, for boiling water reactor systems, the containers that employ the "rod and recess" design that falls within the scope of the claims of the above-referenced patent application as set forth above provide an even greater increase of approximately 28% in the amount of spent nuclear fuel that can be stored with a minimal increase in the weight and size of the storage containers as compared to other competitor containers available on the market.

9. Upon initial scrutiny, one skilled in the art of storage and transportation systems for spent nuclear fuel would not think to use the rod and recess technology that is the subject of the claims of the '879 patent for connectivity between tubes in a spent nuclear fuel containment system basket, which holds the nuclear spent fuel. This is because, at first glance, the approach appears too simple and presents neither obvious strength of connectivity between tubes, nor sufficient heat transfer paths for very hot spent nuclear fuel. Also at first glance, the design does not appear to provide for adequate mechanical ligaments for accident condition load transmission and distribution through the structure so that both the basket structure of the container and the spent nuclear fuel disposed therein remain geometrically stable through the range of off-normal and hypothetical accident conditions that a system must withstand as required by applicable Federal regulations.

10. Furthermore, before invention of the rod and recess technology that is the subject of the claims of the '879 patent, one skilled in the art would have been likely to deem such a design as unworkable due to weaknesses in the design. Specifically, given that in some embodiments, the rods are not rigidly or permanently fixed in the opposing recesses, there is potential for relative motion among the tubes. One would be led to assume that "pull-out" forces from accident conditions imposed on the rods would remove them from the recesses, causing unacceptable basket instability. Typically, it has long been accepted that fairly massive structures with extensive welding and very rigid assembly represent the best approach for the basket design in storage and transport

systems for spent nuclear fuel. At the time of the invention of the rod and recess technology that is the subject of the claims of the '879 patent, the perceived connection "looseness" represented a glaring weakness. In addition, at the time of the invention of the rod and recess technology, the depth of the recesses appeared to be another potential weakness under compressive loading, owing to the thinning of the wall material at a naturally weak point at the corners of the tubes.

11. Designs for dry spent nuclear fuel storage and transport containers must comply with Federal regulations governing Type B transportation packages. Such systems must be designed to withstand hypothetical accident conditions, such as, for example, a 9 meter drop onto an essentially unyielding surface. Such a requirement basically means that all energy from the drop condition must be absorbed by the package or cask. In typical rail or marine size casks (about 100 tons to 125 tons), the forces imposed on the containment structure in the packaging resulting from deceleration in connection with a 9 meter free drop approach 60 “g”. Thus, an imparted force from a 60 g deceleration of the containment system is typical of the design requirements for hypothetical dry storage and transport accident conditions in order to meet Federal licensing requirements.

12. The structural and mechanical engineering effort to show that dry spent fuel storage and transport systems can meet these burdensome hypothetical accident conditions requires analytical methods and skills that are far removed from log cabin

(i.e., wood house), trailer hitch, and/or fence hinge design. Log cabin, trailer hitch, and fence hinge designs cannot withstand imposed loads of even a small fraction of what must be acceptable for spent fuel dry storage and transport systems. Furthermore, the methods and skills required for these storage and transport systems are even quite distant from the analytical methods applied to wet spent nuclear fuel storage system design. For example, analysis of dry storage and transport systems under hypothetical accident conditions employs very advanced dynamic analysis methods. These analyses require time-history assessments of loads, deformations, rod and recess relative motion, and other basket stability parameters, all in a 3-D model that can require millions of nodes. Highly advanced, non-linear dynamic analysis computer codes like LS-DYNA are used to develop sophisticated accident sequence outputs by incorporating coordinated, but separate, inputs from other codes, such as ANSYS, a code for finite element modeling. Both the LS-DYNA and ANSYS codes are used by National Aeronautic and Space Administration subcontractors for aircraft, rocket, and space shuttle design analysis and evaluation under extreme performance conditions. Thus, the design of spent nuclear fuel storage and transport systems requires highly sophisticated analysis for assessment of system performance under demanding hypothetical accident conditions. These analysis methods have been used to show that this "rod and recess" technology, the subject of this application, is able to meet regulatory requirements for spent nuclear fuel transport and storage containers.

13. As mentioned above, the above-identified Office Action rejects certain claims in view of U.S. Patent 4,630,738 issued to Bosshard in combination with other references. It should be noted that the structures described by Bosshard are for wet spent nuclear fuel storage systems. The Federal regulatory requirements regarding accident conditions and the resulting loads therefrom that must be applied to such wet storage systems are much less demanding than those imposed on Type B containers employed for dry spent nuclear fuel storage and transport systems. This is because the most limiting accident conditions to which wet storage systems may be exposed result from seismic disturbances such as earthquakes. As a consequence, such systems are typically designed to withstand a peak acceleration/deceleration of about 1 g, which is $1/60^{th}$ of the design requirement for dry spent nuclear fuel storage and transport systems. Upon reading Bosshard, one skilled in the art will appreciate that the designs described by Bosshard are subject to such lower design requirements and that such designs may not be workable for Type B container baskets employed for dry spent nuclear fuel storage and transport systems.

I hereby declare that all statements made herein of my own knowledge are true and that all statements are made on information and belief and are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Charles W. Pennington

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August 26, 2008

Date